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Determinants of Recognition of Pregnancy Danger Signs Among Mothers Attending Antenatal Care in Dire Dawa Health Facilities, Eastern Ethiopia, 2025

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Abstract

Introduction: Maternal mortality in Dire Dawa is driven by delays in recognizing and responding to obstetric danger signs, influenced by socio-economic, cultural, and healthcare access factors. Despite better antenatal care, local data on these issues are lacking. This study aimed to provide context-specific evidence to improve health literacy, referral systems, and reduce preventable maternal deaths, supporting Ethiopia's maternal health goals.

Objective: To assess the determinants of pregnancy danger signs among mothers attending antenatal care at Hospitals in Dire Dawa Administration, eastern Ethiopia, in 2025.

Materials and Methods: This case-control study assessed determinants of pregnancy danger signs among 369 pregnant women in Dire Dawa, Ethiopia, from March 1 to April 1, 2025. A total of 118 cases were selected through systematic random sampling, while 256 controls were chosen using consecutive sampling. Data were collected using interviewer-administered questionnaires and medical record checklists via Kobo Toolbox, ensuring consistency and reliability ($k = 0.81$). Data analysis was conducted in SPSS version 26. Bivariable logistic regression was used to identify candidate variables ($p < 0.25$) for multivariable logistic regression, which determined independent predictors of pregnancy danger signs at a 95% confidence interval and p -value < 0.05 . The goodness-of-fit of the final model was tested using the Hosmer-Lemeshow test.

Results: This case-control study in Dire Dawa, Ethiopia, identified significant determinants of pregnancy danger signs among 369 pregnant women. Multivariable logistic regression revealed that not attending antenatal care follow-up (AOR = 6.41, 95% CI: 2.59, 15.86), tobacco use (AOR = 15.64, 95% CI: 4.18, 58.47), anemia (AOR = 2.42, 95% CI: 1.21, 4.84), diabetes mellitus (AOR = 8.92, 95% CI: 4.00, 19.92), and MUAC less than 23 cm (AOR = 2.60, 95% CI: 1.19, 5.67) were significantly associated with increased odds of experiencing danger signs.

Conclusion and Recommendation: Pregnancy danger signs were strongly associated with lack of ANC follow-up, tobacco use, anemia, diabetes, and poor nutritional status. The findings highlight the critical need for interventions promoting antenatal care adherence, tobacco cessation, and management of anemia, diabetes, and malnutrition to reduce pregnancy danger signs and improve maternal health outcomes.

Keywords: pregnancy danger sign; risk factors; pregnant women; Dire Dawa

Introduction

Maternal morbidity and mortality remain major global public health challenges, with obstetric danger signs serving as early indicators of potentially life-threatening complications during pregnancy [1]. These danger signs such as vaginal bleeding, severe abdominal pain, visual disturbances, convulsions, reduced fetal movement, and preeclampsia—require urgent medical attention to safeguard maternal and fetal health [2]. Despite improved antenatal care (ANC) coverage worldwide, 99% of maternal deaths still occur in low- and middle-income countries (LMICs), with sub-Saharan Africa accounting for about 69%, largely due to delays in recognizing symptoms and seeking timely care [3].

In Ethiopia, maternal mortality remains high at 267 deaths per 100,000 live births, with preventable obstetric complications responsible for most of these deaths [3, 4]. Dire Dawa, an urban administrative region in eastern Ethiopia, presents unique challenges due to socio-cultural diversity, high migrant populations, and inequities in healthcare access, making it a critical area for investigating determinants of pregnancy danger signs [4]. The occurrence of these danger signs is shaped by multiple factors, including biological risks such as anemia, hypertension, infections, and malnutrition; socio-demographic determinants such as early or late maternal age, poverty, and low educational attainment; and health system barriers such as understaffed facilities, poor

ANC quality, and limited risk screening [5]. Cultural norms, including delayed decision-making, reliance on traditional remedies, and low female autonomy, further hinder timely health-seeking behavior [6].

Although ANC coverage in Dire Dawa exceeds 80%, the prevalence of pregnancy danger signs—such as severe bleeding, hypertensive disorders, and reduced fetal movement—remains high, indicating that ANC attendance alone is insufficient to prevent complications [7]. Risk factors such as poor nutrition, maternal anemia, adolescent or advanced maternal age, and pre-existing medical conditions heighten vulnerability [8]. Weak referral systems, inconsistent ANC quality, and inadequate follow-up care exacerbate the problem [9]. Furthermore, socio-economic disparities and cultural diversity shape maternal health literacy and delay responses to obstetric emergencies [10].

Despite national efforts to improve maternal health, there is limited evidence on how socio-economic status, cultural norms, and health system performance interact to influence the occurrence and recognition of pregnancy danger signs among ANC attendees in urban Ethiopia. This evidence gap is particularly significant in diverse urban settings like Dire Dawa, where service delivery challenges are more pronounced [11]. Therefore, the aim of this study was to assess the interplay of these factors and their influence on the occurrence and recognition of pregnancy danger signs among ANC attendees in Dire Dawa.

Materials and Methods

Study Area, Period and Design

Dire Dawa is situated approximately 515 kilometers east of Addis Ababa, the nation's capital, and serves as an important urban center in the region. The city encompassed a diverse population of 506,640 residents, with 58% living in urban areas and 42% in rural locales across its 9 urban and 38 rural kebeles (48). This unique demographic distribution highlighted the differing health needs within the community. The health infrastructure in Dire Dawa included 2 governmental hospitals, 6 private hospitals, 16 health centers, and 17 private clinics, as reported by the Dire Dawa Health Bureau (49). The combination of urban and rural settings, alongside the availability of varied healthcare facilities, made Dire Dawa a significant area for conducting public health research during the specified study period. Case control study was conducted in Dire Dawa

Administrative, a chartered city in Ethiopia, from March 1 to April 1, 2025.

Population

All pregnant women attending antenatal care (ANC) at Dire Dawa public and private hospitals was source population and selected pregnant women attending antenatal care (ANC) at Dire Dawa public and private hospitals was study population.

Cases: all pregnant women attending ANC and labor/delivery and emergency wards with one or more of the following pregnancy danger signs: severe vaginal bleeding, severe headaches with blurred vision, swelling of the face, fingers, and feet, persistent vomiting, severe abdominal pain, convulsions, and cessation of fetal movement during data collection.

Controls: Pregnant women attending ANC and labor/delivery and emergency wards who were free from the following pregnancy danger signs (severe vaginal bleeding, severe headaches with blurred vision, swelling of the face, fingers, and feet, persistent vomiting, severe abdominal pain, convulsions, and cessation of fetal movement) were included in the study.

Eligibility

Cases: Inclusion Criteria: Pregnant women attending ANC and labor/delivery and emergency wards at Dire Dawa hospitals during the study period who met the criteria for being a 'case' (as previously defined, likely having one or more pregnancy danger signs).

Exclusion Criteria: Pregnant women diagnosed with severe mental illnesses or cognitive impairments affecting their ability to understand or respond to questions, as well as those who were severely ill and required emergency obstetric or medical care at the time of data collection, were excluded from the study.

Controls: Inclusion Criteria: Pregnant women attending ANC and labor/delivery and emergency wards at Dire Dawa hospitals during the study period who met the criteria for being a 'control' (as previously defined, likely being free from the pregnancy danger signs).

Sample size determination and sampling procedure

Sample size determination was performed using the double proportion formula implemented in EPI INFO version 7 statistical software. Key assumptions guiding the calculation were a 95% confidence level, 80% statistical power, a case-to-control ratio of 1:2, and an anticipated non-response rate of 10%. The estimates for the determinants of pregnancy danger

signs used in the formula were derived from a previous study conducted in Shashemene, Ethiopia (50).

The study was conducted in Dire Dawa city administration, which has a total of seven hospitals (two public and five private). To ensure representation of both public and private sectors while balancing feasibility and logistical practicality for data collection, three hospitals were purposively selected: two public hospitals and one private hospital.

This purposive selection aimed to reflect the higher patient load in public hospitals (selecting both available public hospitals) and proportionally represent the private sector (selecting one out of five private hospitals) within logistical constraints. Within the selected hospitals, a total of 1000 pregnant women attended ANC in the month prior to data collection: 500 at Dilchora Hospital (75 cases and 425 controls), 320 at Sabian Primary Hospital (48 cases and 272 controls), and 180 at Delt Hospital (28 cases and 152 controls). Controls (women not identifying pregnancy danger signs) were selected using systematic sampling from the ANC registries. The sampling interval for controls was determined based on the total number of eligible controls in the registry and the required number of controls from that hospital.

Operational Definition

Danger signs in pregnancy refer to specific clinical symptoms and conditions during the current pregnancy that indicate potential complications requiring immediate medical attention. These signs typically include severe abdominal pain, heavy bleeding, severe headaches, blurred vision, high fever, severe vomiting, reduced fetal movement, and signs of preterm labor [12].

Anemia in Pregnancy: Hemoglobin concentration less than 11g/dl irrespective of gestational age is considered as anemia among pregnant women [12].

Body Mass Index: a person's weight in kilograms divided by the square of the person's height in meters (kg/m^2) [13].

Normal weight is defined as a BMI of 18.5-24.9 kg/m^2 , underweight as <18.5 , overweight as 25-29.9, and obesity as ≥ 30 , per WHO classification.

Gestational Age: use last menstrual period as the basis for dating in days then converted to weeks and treated as an ordered categorical variable [13].

Alcohol use during current pregnancy was defined as ever use of drinks with industrially prepared alcoholic content (ethanol or ethyl content) or locally prepared

ones, like Teji, Areki and Tela during current pregnancy irrespective of its dose and frequency [14]. Tobacco use during current pregnancy was defined as ever use of any of the tobacco products during current pregnancy. The use of cigarette or other forms of smoking tobacco like shisha/hookah and bidi and non-smoking like snuff or chewing tobacco during current pregnancy irrespective of its dose and frequency [15].

Data Collection Tools and Procedures

Data were collected using a structured, pretested questionnaire adapted from previous studies and modified for relevance to pregnant women in Dire Dawa. The tool was translated into Afan Oromo, Somali, and Amharic, then back-translated into English to ensure accuracy, and covered socio-demographic, obstetric, medical, behavioral, and nutrition-related factors. Data were obtained through interviews, medical record reviews, and physical measurements for anemia, MUAC, and BMI, with trained midwives supervising the process. However, reliance on maternal recall for danger signs and self-reported symptoms like blurred vision or abdominal pain-without clinical confirmation-may introduce recall bias and misclassification, underscoring the need for clear probing protocols and standardized interpretation.

Data Quality Control

The structured questionnaire was developed in English, translated into Afan Oromo, Somali, and Amharic, and back-translated to ensure accuracy and consistency. Data collectors and supervisors received two days of training on study objectives and questionnaire content, followed by a pilot test with 10% of the sample at a facility excluded from the main study, after which necessary revisions were made. During data collection, the principal investigator and supervisors conducted daily reviews and on-the-spot checks to ensure completeness and consistency. For data management, double data entry was performed by two independent clerks, and the datasets were cross-checked to identify and correct discrepancies, ensuring data quality.

Data Analysis and Interpretation

The data was entered by using the Kobo tool collect software, and then exported to SPSS version 24 for analysis. The characteristics of the study participants were explored using frequency, percentage, figures, and descriptive summaries to describe the study variables through bivariate analysis. Multivariable

logistic regression analysis was conducted to examine the independent effect of each variable on the outcome variable. Variables with a p-value < 0.25 in the bivariate analysis were included in the multivariable analysis. The goodness of fit was evaluated using the Hosmer-Lemeshow statistic and Omnibus tests. The direction and strength of statistical associations were measured by odds ratios with 95% confidence intervals (CI). Finally, statistical significance was declared at a p-value < 0.05.

Results

Sociodemographic Characteristics

The study included 356 women, with 118 cases (pregnancy danger signs) and 238 controls, both with response rates around 96.5%. The mean age was higher among cases 29.35 ($\pm$ 5.26 years) than controls 26.44 ($\pm$ 5.33 years). Most women in both groups were aged 30 years and above cases 65 (18.3%; controls 76 (21.3%) and resided in urban areas cases 83 (23.3%; controls 209 (58.7%) (Table 1).

Table 1: Socio-demographic characteristics of pregnancy danger sign in eastern Ethiopia, 2025.

Variables	Pregnancy Danger Sign	
	Case = 118	Control = 256
Maternal Age		
15-24	24 (6.8%)	81 (22.9%)
20-29	73 (20.7%)	134(37.6%)
30 and above	21 (5.9%)	23 (6.5%)
Residence		
Urban	83 (23.3%)	209 (58.7%)
Rural	35 (9.8%)	29 (8.1%)
Marital Status		
Single	1(0.3%)	2(0.6%)
Married	110 (30.9%)	232 (65.2%)
Divorce	5(1.4%)	2(0.6%)
Windowed	2 (0.6%)	2 (0.6%)
Educational Status (Mother)		
Nonformal	47 (13.2%)	66 (18.5%)
Primary	26 (7.3%)	57 (26.0%)
Secondary and above	45 (12.6%)	115 (32.3%)
Husband Educational Status		
Nonformal	38 (11.7%)	30(8.7%)
Primary	29 (8.5%)	37 (10.8%)
Secondary and above	43(12.5%)	165 (48.1%)

Obstetrics and Health-Related Characteristics

Most women in the control group had regular antenatal care follow-up 226 (63.5%) and fewer than four ANC visits 136(38.9%). Additionally, 141

(47.3%) controls had 1-3 children, and a higher proportion of controls 201(56.5%) reported consulting a healthcare provider about pregnancy planning (Table 2).

Table 2: Obstetrics and health-related characteristics of the study participants in Dire Dawa, Ethiopia 2025 (n=356).

Variables	Pregnancy Danger Sign	
	Case = 118 (33%)	Control = 256 (71%)
Follow-Up Appointments for Antenatal Care		
Yes	93(26.4%)	226(63.5%)
No	25(7%)	12(3.4%)
Number of ANC Visit for The Last Pregnancy		
<4	57(16.3%)	136(38.9%)
≥4	60(17.1%)	97(27.7%)
Number of Children		
1-3	68(22.8%)	141(47.3)
≥4	44(14.8%)	45(15.1%)
Consulted a Healthcare Provider Regarding your Pregnancy Plans		
Yes	67(18.8%)	201(56.5)
No	48(13.5%)	34(9.6%)
Consider this Pregnancy to be Planned		

Yes	67(18.8%)	197(55.3%)
No	51(14.3%)	41(11.5%)
Did you Experience any Problem Pregnancy in The Past?		
Yes	47(13.2%)	80(22.5%)
No	71(19.9%)	158(44.4%)
Place of Previous Delivery		
Home	9(2.5%)	5(1.4%)
Health center	46(12.9%)	21(5.9%)
Hospital	63(17.7%)	212(59.6%)
Timing of First ANC Visit for This Pregnancy		
First trimester (0-3 months)	17(4.8%)	63(17.7%)
Second trimester (4-6 months)	55(15.4%)	100(28.1%)
Third trimester (7-9 months)	46(12.9%)	75(21.1%)

Behavioral Habits/History

Among cases, 16 (4.5%) currently smoked cigarettes, compared to 18(5.1%) of controls; past cigarette smoking was reported by cases 14 (3.9%) and controls 16 (4.5%). Alcohol consumption was slightly higher among cases, with 30 (8.4%) reporting drinking

alcohol versus 22 (6.2%) in controls. Additionally, use of any form of tobacco products was noted in cases 28(7.9%) compared to only controls 4(1.1%). Conversely, a larger proportion of controls 90 (25.3%) reported not using tobacco, compared to cases 90 (65.7%) (Table 3).

Table 3: Behavioral habits related characteristics of the Study Participants in Dire Dawa, Ethiopia 2025 (n=356).

Variables	Pregnancy Danger Sign	
	Case = 118 (33%)	Control = 256 (71%)
Currently Smoke Cigarettes		
Yes	16(4.5%)	18(5.1%)
No	102(28.7%)	220(61.8%)
Smoked Cigarettes in The Past		
Yes	14(3.9%)	16(4.5%)
No	104 (29.2%)	222(62.4%)
Consumed Alcoholic Beverages		
Yes	30(8.4%)	22(6.2%)
No	88(24.7%)	216(60.7%)
Used Any Form of Tobacco Products		
Yes	28(7.9%)	4(1.1%)
No	90(25.3%)	234(65.7%)

Magnitude of current Pregnancy Danger Signs

Severe abdominal pain 30(25.4%), signs of preterm labor 29 (24.6%), and blurred vision 21(17.8%) were

the most frequently reported danger signs among cases. Together, these three symptoms accounted for 80 (67.8%) of all cases of the total study population.

Table 4: Magnitude of current pregnancy danger signs Participants in Dire Dawa, Ethiopia 2025 (n=356).

Variables	Pregnancy Danger Sign	
	Case = 118 (33%)	Control = 256 (71%)
Vaginal Bleeding		
Yes	17(4.8%)	3(0.8%)
No	101(28.4%)	235(66%)
Severe Abdominal Pain		
Yes	30(8.4%)	4(1.1%)
No	88 (24.7%)	234(65.7%)
Persistent Headaches		
Yes	15(4.2%)	4(1.1%)
No	103(28.9%)	234(65.7%)
Swollen Hands/Face		
Yes	18(5.1%)	3(0.8%)
No	100(28.1%)	235(66%)
Blurred Vision		
Yes	21(5.1%)	4(0.8%)

No	97(28.1%)	(66%)
Any Episodes of Loss of Consciousness		
Yes	15(4.2%)	0(0%)
No	103(28.9%)	230(66.9%)
Decrease in Fetal Movement		
Yes	7(2%)	0(0%)
No	111(31.2%)	230(66.9%)
A Sudden Increase in Weight or Swollen Limbs		
Yes	18(5.1%)	4(1.1%)
No	100(28.1%)	234(65.7%)
Any Signs of Preterm Labor		
Yes	29(8.1%)	0(0%)
No	89(25%)	230(66.9%)
Persistent Fever		
Yes	13(3.7%)	3(0.8%)
No	105(29.5%)	135(66%)

Medical History

Among individuals with a pregnancy danger sign (Case), 13(3.7%) were diagnosed with diabetes mellitus, 20(5.6%) were diagnosed with a genital tract infection, and 15(4.2%) experienced any abnormal vaginal discharge. In the control group, 3(0.8%) were diagnosed with diabetes mellitus, 32 (9%) were diagnosed with a genital tract infection, and 19(5.3%) experienced any abnormal vaginal discharge.

Nutritional and physical activity habitués

Among individuals with a Case, 50 (14%) were diagnosed with anemia, 38 (10.7%) had a Mid-Upper Arm Circumference less than 23 cm, and 15 (4.2%) had a Body Mass Index (BMI) less than 18.5. In the control group, 39 (11%) were diagnosed with anemia, 26 (7.3%) had a Mid-Upper Circumference less than 23 cm, and 16(4.5%) had a Body Mass Index less than 18.5.

Factors associated with pregnancy danger sign among pregnant mothers

In this study, 13 variables were candidates and entered in multivariate analysis those their p-value was <0.25, in binary logistic regression analysis. Of which

five variables were significantly associated with the outcome variable in the multiple logistic regression analysis models ($p < 0.05$). Based on the multiple logistic regression analysis, several factors were found to be significantly associated with the presence of pregnancy danger signs. After adjusting for other variables, not having follow-up appointments for antenatal care was strongly associated with an increased risk of pregnancy danger signs (AOR = 6.41, 95% CI: 2.59, 15.86, $P < 0.0001$). Similarly, using any form of tobacco products significantly increased the odds of experiencing pregnancy danger signs (AOR = 15.64, 95% CI: 4.18, 58.47, $P < 0.0001$). A diagnosis of anemia during pregnancy was also associated with a higher likelihood of pregnancy danger signs (AOR = 2.42, 95% CI: 1.21, 4.84, $P = 0.01$). Furthermore, having been diagnosed with diabetes mellitus during pregnancy was a very strong predictor of pregnancy danger signs (AOR = 8.92, 95% CI: 4.00, 19.92, $P < 0.0001$). Finally, a Mid-Upper Arm Circumference (MUAC) less than 23 cm was significantly associated with an increased risk of pregnancy danger signs (AOR = 2.60, 95% CI: 1.19, 5.67, $P = 0.016$) (Table 5).

Table 5: Bivariable and Multivariable analysis for pregnancy danger sign and associated factors among pregnant mother in Dire Dawa hospital, 2025.

Variables	PDS		COR (95% CI)	AOR (95% CI)	P-Value
	Case	Control			
Maternal Age					
10-19	2(0.6)	13(3.7)	1	1	-
20-29	51(14.4)	148(41.9)	5.71(1.24, 26.25	1.78(0.24,13.37)	0.57
30 and above	65(18.4)	74(21)	2.55(1.61,4.04)	1.13(0.15,8.52)	0.90
Marital Status					
Married	110(30.9)	232(65.2)	1	1	-
Unmarried	8(2.2)	6(1.7)	2.81(0.95,8.30)	1.09(0.22,5.33)	0.92
Residence					
Urban	83(23.3)	209(58.7)	1	1	-

Rural	35(9.8)	29(8.1)	3.04(1.75,5.29)	0.84(0.32,2.19)	0.72
Follow-up Appointments for Antenatal Care					
Yes	93(26.4)	226(63.5)	1	1	-
No	25(7)	12(3.4)	5.06(2.44,10.5)	6.41(2.59,15.86)	0.0001
Number of ANC Visit for The Last Pregnancy					
≥4	60(17.1)	97(27.7)	1	1	-
<4	57(16.3)	136(38.9)	0.68(0.43,1.06)	0.78(0.42,1.44)	0.43
Number of Children					
1-3	68(22.8)	141(47.3)	1	1	-
≥4	44(14.8)	45(15.1)	2.03(1.22,30.36)	0.77(0.37, 1.60)	0.48
Consider this Pregnancy to be Planned					
Yes	67(18.8)	197(55.3)	1	-	-
No	51(14.3)	41(11.5)	3.66(2.23,6.01)	0.66(0.30,1.47)	0.43
Place of Delivery					
Health facility	109	233	1	1	-
Home	9	5	3.85(1.26,11.75)	1.64(0.24,11.10)	0.61
Currently Smoke Cigarettes					
Yes	16(4.5)	18(5.1)	1.91(0.94,3.91)	2.35(0.90,6.11)	0.08
No	102(28.7)	220(61.8)	1	1	-
Using Any Form of Tobacco					
Yes	28(7.9)	4(1.1)	3.34(1.83,6.12)	15.64(4.18,58.47)	0.0001
No	90(25.3)	234(65.7)	1	1	-
Having Anemia					
Yes	50(14)	39(11)	3.75(2.27,6.19)	2.42(1.21,4.84)	0.01
No	68(19.1)	199(55.9)	1	1	-
Known Diabetes Mellitus					
Yes	42(11.8)	17(4.8)	7.18(3.86,13.37)	8.92(4.00, 19.92)	0.0001
No	76(21.3)	221(62.1)	1	1	-
Mid-Upper Arm Circumference (MUAC) Less Than 23 cm					
Yes	15(4.2)	16(4.5)	3.87(2.21,6.79)	2.60(1.19,5.67)	0.016
No	103(28.9)	222(64.2)	1	1	-

Discussion

Our findings indicate that women who did not have follow-up antenatal care (ANC) appointments were significantly more likely to experience pregnancy danger signs, with an adjusted odds ratio (AOR) of 6.41 (95% CI: 2.59-15.86, $P < 0.0001$), highlighting the critical role of consistent ANC visits in pregnancy health. This aligns with existing literature from Ethiopia, where studies have demonstrated that women attending at least four ANC visits are more aware of pregnancy danger signs, owing to increased interaction with healthcare providers that enhances their knowledge and ability to recognize warning signs early [16]. Similar research from other countries, such as Kenya and Nigeria, also underscores the protective effect of regular ANC attendance against adverse maternal outcomes. In the context of our study, these findings are particularly relevant because they reinforce the importance of early and consistent engagement with maternal health services in our target population. Our community-based data suggest that women who missed follow-up ANC appointments may lack critical information about

pregnancy danger signs, leading to delayed recognition and response to complications. Additionally, the high prevalence of danger signs among women with irregular or no ANC follow-up underscores gaps in health education and access, which are common challenges in our setting. The strong association observed emphasizes the importance of promoting regular ANC visits to improve maternal awareness and reduce pregnancy-related complications. Notably, while our study primarily supports the established understanding of ANC's benefits, some unexpected findings, such as the high prevalence of certain danger signs despite regular visits, suggest that factors like quality of care and health literacy may also influence outcomes. This indicates that merely increasing the frequency of visits might not be sufficient without ensuring the quality and effectiveness of ANC services provided.

The strengths of this study include a robust sample size and adjustment for confounders, but limitations such as potential recall bias and the cross-sectional design restrict causal inferences. Overall, our results reinforce the need for policies that ensure accessible and quality ANC services to mitigate pregnancy risks

effectively, particularly emphasizing the importance of health education during ANC visits to empower women with the knowledge necessary for early detection and management of pregnancy complications. Our study found that the use of any form of tobacco products was significantly associated with an increased risk of experiencing pregnancy danger signs, with an adjusted odds ratio (AOR) of 15.64 (95% CI: 4.18-58.47, $P < 0.0001$), underscoring the profound impact of behavioral risk factors on maternal health. This finding aligns with extensive literature demonstrating that tobacco use during pregnancy, including smoking and smokeless forms, leads to vasoconstriction, placental insufficiency, hypoxia, and oxidative stress, thereby elevating risks of adverse outcomes such as low birth weight, preterm delivery, placental abruption, stillbirth, and fetal distress [17,18]. These findings highlight the critical need for behavioral interventions targeting substance use during pregnancy to reduce obstetric danger signs and improve maternal and neonatal outcomes. The strengths of this study include a robust sample size and adjustment for confounders, but limitations such as potential recall bias and the cross-sectional design restrict causal inferences. Overall, our results reinforce the need for policies that ensure accessible and quality ANC services to mitigate pregnancy risks effectively, particularly emphasizing the importance of health.

Our findings indicate that a diagnosis of anemia during pregnancy was significantly associated with an increased likelihood of experiencing pregnancy danger signs, with an adjusted odds ratio (AOR) of 2.42 (95% CI: 1.21-4.84, $P = 0.01$), highlighting the critical role of maternal nutritional status in pregnancy outcomes. This aligns with existing literature from Ethiopia and other countries such as India and Nigeria, where anemia primarily due to iron deficiency is linked to maternal fatigue, preterm labor, postpartum hemorrhage, and fetal complications like intrauterine growth restriction [19,20]. Anemia impairs oxygen delivery, exacerbating maternal and fetal stress, which may manifest as danger signs during pregnancy. While our study reinforces the importance of nutritional interventions, an unexpected observation was the relatively high prevalence of anemia despite routine antenatal care, possibly reflecting underlying socioeconomic factors or dietary deficiencies not fully captured in this study. The strengths of this research include its focus on modifiable health conditions and adjustment for

potential confounders; however, limitations such as reliance on self-reported data and cross-sectional design restrict causal interpretations. Overall, these findings underscore the need for integrated nutritional programs and early detection strategies to mitigate obstetric risks associated with anemia.

Our study revealed that a diagnosis of diabetes mellitus during pregnancy was a remarkably strong predictor of pregnancy danger signs, with an adjusted odds ratio (AOR) of 8.92 (95% CI: 4.00-19.92, $P < 0.0001$), emphasizing the significant impact of metabolic disorders on maternal health. This finding is consistent with existing literature from Ethiopia, Nigeria, and India, where both pre-existing and gestational diabetes mellitus are associated with increased risks of hypertensive disorders such as preeclampsia, fetal distress, and prolonged labor, primarily due to vascular dysfunction and metabolic dysregulation [21,22]. In countries with limited healthcare resources, poorly managed diabetes can exacerbate obstetric complications, underscoring the importance of early screening and proper management. An unexpected observation was the high prevalence of diabetes-related complications, possibly reflecting gaps in antenatal screening or glycemic control practices. The strength of our study lies in highlighting the critical role of diabetes as a modifiable risk factor for pregnancy danger signs; however, limitations include potential recall bias and the cross-sectional nature of the study, which precludes establishing causality. Overall, these findings reinforce the urgent need for integrated screening and management protocols for diabetes during pregnancy to reduce adverse maternal outcomes.

Our findings demonstrated that a mid-upper arm circumference (MUAC) less than 23 cm was significantly associated with an increased risk of pregnancy danger signs, with an adjusted odds ratio (AOR) of 2.60 (95% CI: 1.19-5.67, $P = 0.016$), underscoring the importance of maternal nutritional status in pregnancy outcomes. This aligns with existing research from Ethiopia, Nigeria, and India, where poor nutritional status, as indicated by low MUAC, is linked to compromised immunity, reduced muscle strength, and decreased physiological reserves, leading to heightened susceptibility to infections, prolonged labor, and postpartum hemorrhage [23,24]. These findings suggest that nutritional assessment using MUAC can serve as a simple, cost-effective tool for identifying women at higher risk of

obstetric complications, particularly in resource-limited settings. An unexpected aspect of our study was the relatively high prevalence of low MUAC among pregnant women despite ongoing nutritional interventions, indicating potential gaps in dietary intake or socioeconomic barriers. The strengths of this study include its focus on an easily measurable anthropometric indicator and its relevance to low-resource settings; however, limitations such as the cross-sectional design and potential confounders not accounted for, like micronutrient deficiencies, restrict causal inferences. Overall, these results emphasize the need for targeted nutritional interventions and routine MUAC screening to mitigate pregnancy danger signs associated with under nutrition.

Conclusion

This study identified key modifiable factors associated with pregnancy danger signs. A not Follow-up appointment for antenatal care was strongly linked to increased risk, as was tobacco use. Medical conditions such as anemia and diabetes mellitus significantly elevated the likelihood of danger signs, alongside poor nutritional status indicated by MUAC less than 23 cm. Strengthen comprehensive antenatal care by improving access, ensuring routine screening, nutritional assessment, and integrating health education on pregnancy danger signs and tobacco cessation. Empower pregnant women and communities through targeted awareness and support systems to promote early recognition and timely care-seeking. Additionally, policymakers should prioritize resource allocation, workforce training, and community-based interventions to enhance the overall quality and utilization of maternal health services.

Abbreviation and Acronyms

ANC - Antenatal Care; BMI - Body Mass Index; CI - Confidence Intervals; CS - Cesarean Section; DM - Diabetes Mellitus; GA - Gestational Age; GTI - Genital Tract Infection; ICT - Information and Communication Technology; IUGR - Intrauterine Growth Restriction; LMIC - Low- and Middle-Income Countries; MUAC - Mid-Upper Arm Circumference; RERC - Research Ethical Review Committee; UTI - Urinary Tract Infection; VIF - Variance Inflation Factor; WHO - World Health Organization

Declarations

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Author Contribution Statement

Sabrina Abdi: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Software; Writing - original draft; Writing - review & editing.

Aliya Nuri: Conceptualization; Formal analysis; Methodology; Software; Writing - review & editing.

Nigus Kassie: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Software; Writing - original draft; Writing - review & editing.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

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Ethics Approval and Consent to Participate

Ethical approval was obtained from the Institutional Review Board of Dire Dawa University's College of Medicine and Health Sciences, and permission letters were secured from the Dire Dawa Administrative Health Bureau and participating health facilities. Written informed consent was obtained from all participants after explaining the study's purpose, benefits, and risks, and confidentiality was maintained throughout data collection. However, clarification is needed regarding participants under 18 years of age-whether they were included, and if so, whether parental or guardian consent and participant assent were obtained in line with ethical requirements, or if minors were excluded entirely.

Availability of Data and Materials

The participants de-identified data used for current study will be available upon submitting reasonable request from the corresponding author in either SPSS or Stata format and as per the permission obtained from senior project principals.

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